HIGH SCHOOL AND UNIVERSITY MATRICULATION EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1942

CHEMISTRY 2

Time—3 hours.

Note—You are not expected to answer all of the questions, but do as many as you can.

In problems show all steps in full. Calculations should be completed correct to one decimal place. You may use logarithmic tables.

Your answers are to be written in this booklet. Pages 8 and 11 may be used for rough work if required.

Atomic weights: Carbon = 12; Nitrogen = 14
Oxygen = 16; Sodium = 23
Boron = 11; Chlorine = 35.5
Hydrogen = 1.

Values

1. Complete each statement in the space provided:

1 (*a*) If a space is occupied by a mixture of gases, each gas exerts the same pressure as it would exert if

....

1 (*b*) The chemical name of caustic potash is

....

1 (*c*) A metal commonly used in fusible alloys is

....

1 (*d*) The weight of 22.4 litres of ammonia gas measured at N.T.P. is

....

1 (*e*) The volume of 11 grams of carbon dioxide gas measured at N.T.P. is

....

(*f*) A dilute solution of copper chloride is in ionic equilibrium as illustrated by the equation $CuCl_2 \rightleftarrows Cu^{++} + 2Cl^{-}$. The addition of some concentrated potassium chloride solution will displace the

1 equilibrium to the ....thus increasing

1 the concentration of ....

This is indicated by a color change from ....

2 to..

3 (*g*) In the Solvay process for the manufacture of sodium carbonate

....(is, are)

introduced at the top and..

at the bottom of the tower. The equation for the reaction is

2 ....

Values

(*h*) When solutions of lead nitrate and potassium chloride are mixed a white precipitate forms at once. Write an ionic equation to illustrate this reaction.

2 ....

(*i*) If the freezing point of 100 grams of water containing 5 grams of sugar is –0.27°C, then the freezing point of 100 grams of water containing 5 grams of an organic compound whose atomic weight is

1 half that of sugar should be approximately ....

2. Underline clearly the correct answer.

1 (*a*) The essential element alloyed with iron in the manufacture of armour plate is (1) vanadium, (2) chromium, (3) tungsten, (4) nickel.

1 (*b*) Reactions which are accompanied by the production of heat are said to be (1) efflorescent, (2) thermogenic, (3) endothermic, (4) exothermic, (5) thermodynamic.

1 (*c*) A drop of sodium sulphate solution is placed upon a piece of neutral litmus paper. The part under the drop (1) turns blue, (2) turns red, (3) is bleached, (4) remains unchanged.

1 (*d*) One-half gram-molecular weight of common salt dissolved in 1000 grams of water lowers the freezing point of the solution by (1) 0.93°C (2) 1.86°C (3) 3.72°C (4) 0.52°C.

1 (*e*) To a solution of ferric chloride and ammonium thiocyanate some ammonium chloride is added. Observation: (1) no color change takes place, (2) the solution turns a deeper red, (3) the solution turns a fainter red, (4) the solution turns greenish yellow.

1 (*f*) Any series of compounds which have similar chemical properties and whose formulae are all included in a single general expression is said to be (1) isomeric, (2) homologous, (3) homogeneous, (4) a paraffin series, (5) an olefine series.

1 (*g*) When concentrated hydrochloric acid is added to a saturated solution of sodium chloride some of the salt precipitates out as crystals. The explanation of this phenomenon rests upon (1) Raoult's Law, (2) Le Chatelier's Law, (3) Abegg's Law, (4) Law of Constant Composition, (5) Bladgen's Law.

1 (*h*) The relationship of the atomic number concept to the Periodic Law was introduced by (1) Becquerel, (2) Roentgen, (3) Moseley, (4) Crookes, (5) Rutherford.

1 (*i*) The disintegration of radium produces three types of ray. Those rays not deflected by a magnetic field are known as the (1) alpha rays, (2) beta rays, (3) gamma rays.

3. Write the chemical formula for each of the following:

1 (*a*) Silica ....

1 (*b*) Phosphonium chloride ....

1 (*c*) Gypsum ....

1 (*d*) Stannic chloride ....

1 (*e*) Calcium chlorate ....

Values

1 (*f*) White lead ....

1 (*g*) Potassium Ferrocyanide ....

1 (*h*) Cane sugar ....

1 (*i*) Write the structural formula for methyl alcohol.

1 (*j*) Write the structural formula for ethylene dichloride (dichloroethylene).

4. True — False.

State whether each of the following statements is TRUE or FALSE by drawing a circle around the correct response. If it is false, underline the part which is wrong and write in the space provided the word or phrase which, if substituted for the part you underlined, would make the statement TRUE. A mere indication of FALSE without the correction will not be accepted.

1 (*a*) 8 cc. of 5N H_2SO_4 will neutralize 8 cc. of 5N NaOH.

True — False..............................

1 (*b*) The reading of a burette should be taken at the top of the meniscus.

True — False..............................

1 (*c*) A Molar solution of barium hydroxide has 17 grams of replaceable hydroxyl ions per litre.

True — False..............................

1 (*d*) Zinc, silver, and copper are in their order of decreasing electropositiveness.

True — False..............................

1 (*e*) Calcium sulphate, strontium sulphate, and barium sulphate are in order of decreasing solubility.

True — False..............................

1 (*f*) As we descend the periodic table in group 7B from fluorine to iodine the elements become less electro-negative.

True — False..............................

1 (*g*) An oxide which under certain conditions will react as an acid and under other conditions as a base is said to be allotropic.

True — False..............................

1 (*h*) A solution of cupric chloride turns neutral litmus red.

True — False..............................

1 (*i*) Many of the properties of chlorine are an average of the properties of iodine and bromine.

True — False..............................

1 (*j*) Salts of aluminium tend to hydrolyze readily.

True — False..............................

[OVER]

Score = R – W

Values

5. In each of the following statements two or more of the suggested completions are True. Underline all of the completions that are NOT True.

2 (*a*) In the Halogen Family there is a steady gradation of properties from fluorine to iodine as follows: (1) their boiling points steadily increase, (2) their hydrides form with increasing readiness, (3) the stability of their compounds decreases, (4) there is a steady increase in specific gravity.

2 (*b*) The following phenomena concerning electrolytes can be explained by means of the Ionic Theory: (1) electrical conductivity of their solutions, (2) their degrees of solubility in water, (3) their abnormal depression of freezing point, (4) the neutralization of acids and bases.

2 (*c*) Aluminium cannot be extracted from its ores by the common process of smelting because: (1) its melting point is too high, (2) due to its high position in the E.M.F. series its compounds are very stable, (3) its oxide is difficult to reduce, (4) molten aluminium has a low specific gravity.

2 (*d*) We are indebted to each of the following men for the discovery of an important law concerning the behavior of gases: (1) Charles, (2) Avogadro, (3) Gay Lussac, (4) Arrhenius.

2 (*e*) A chloride, water, and free chlorine are formed when hydrochloric acid is heated with: (1) lead monoxide, (2) red lead, (3) lead dioxide, (4) stannous oxide.

2 (*f*) The following materials all conform to the Law of Definite Proportions: (1) baking powder, (2) baking soda, (3) gasoline, (4) beet sugar.

10 **6. After the name of each industrial centre given in Column Two, write the letter corresponding to the name of the product given in Column One for which the centre is noted. Thus Turner Valley is noted for petroleum, hence K is written after Turner Valley.**

A Radium

B Aluminium

C Nickel

D Lead-zinc ore

E Clay products

F Gold

G Salt

H Asbestos

I Beet sugar

J Cyanamide

K Petroleum

L Non-ferrous metals

M Explosives

Turner Valley, Alta. ....K..................

Yellowknife, N. W. T. ....

Trail, B. C. ....

Thetford, Quebec ....

McMurray, Alta. ....

Great Bear Lake, N. W. T. ....

Medicine Hat, Alberta ....

Sudbury, Ont. ....

Niagara Falls, Ont. ....

Kimberley, B.C. ....

Arvida, Quebec ....

Values

7. By means of equations show what takes place in—

2 (*a*) The solution of arsenious oxide in sodium hydroxide.

Equation ....

2 (*b*) The hydrolysis of cane sugar.

Equation ....

2 (*c*) A laboratory preparation of bromine.

Equation ....

2 (*d*) The reaction between sand and calcium carbonate at high temperatures.

Equation ....

1 This reaction is of industrial importance in ....

....

2 (*e*) The preparation of sodium hydroxide from sodium carbonate.

Equation ....

1 This reaction will go to completion because ....

....

2 (*f*) The preparation of nitric acid from sodium nitrate.

Equation ....

1 This reaction can be made to go to completion because

....

....

8. Explain the following using appropriate equations in each case:

3 (*a*) When iron and hydrochloric acid are added to a solution of ferric chloride the color of the solution changes from yellow to green.

....

....

....

....

3 (*b*) The glass stopper of a bottle containing sodium hydroxide solution is often found to be stuck fast.

....

....

....

....

3 (*c*) A solution of hyrogen iodide soon goes brown on exposure to the air.

....

....

....

....

Values

9. Suppose A, B, C, D represent four metallic elements.

(1) Strips of A, B and C are placed in a solution of a salt of D (e.g., a nitrate). Strips A and C remain unchanged but B becomes coated with a substance whose color resembles that of metal D.

(2) Strips of A and C are in turn placed in dilute hydrochloric acid. No reaction occurs with metal C, but metal A slowly dissolves liberating a gas which upon testing is found to be hydrogen.

3 (*a*) Arrange the elements in the order in which they would appear in the electro-chemical series.

1.................... 2.................... 3.................... 4....................

1 (*b*) If only one of the elements will displace hydrogen from water, which one is it? ....

1 (*c*) Between which two elements would you place hydrogen?

....

1 (*d*) If the oxides of only two of the elements can be reduced to the metallic state in a stream of hydrogen, which two are they?....................

....

2 **10.** (*a*) Using the Ionic Theory, write the equation to illustrate the neutralization of hydrobromic acid by means of ammonium hydroxide.

Equation ....

2 (*b*) Ethane gas has a formula, C_2H_6. Write the equation representing its complete combustion.

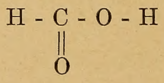
Equation ....

1 (*c*) The volume of air required for the combustion of 20 litres of ethane is.................... litres. (Air is one-fifth oxygen.)

1 (*d*) The formula of ethane is C_2H_6 and of propane, C_3H_8. The formula of ethyl alcohol is C_2H_5OH; hence the formula of propyl alcohol is

....

1 (*e*) The structural formula for formic acid is



$$\begin{array}{c} H - \underset{\underset{\displaystyle O}{\|}}{C} - O - H \end{array}$$

Therefore the structural formula for sodium formate is

....

11. In each of the following cases, will a chemical change take place? State your reasons. Where appropriate, illustrate by an equation.

3 (*a*) Solid ammonium chloride is added to sodium hydroxide solution and heat is applied.

....

....

....

....

....

Values

3 (*b*) Hydrogen sulphide gas is passed into a solution of a zinc salt to which a little hydrochloric acid has been added.

3 (*c*) Sulphur dioxide gas is bubbled into sodium hydroxide solution.

3 **12.** Borax powder ($Na_2B_4O_7$) costs 15¢ a pound; borax crystals ($Na_2B_4O_7.10H_2O$) cost 9¢ a pound. Show which is the more economical to buy?

13. Write briefly on the chemistry of photography, under the following headings:

2 (*a*) Preparation of the sensitized film.

1 (*b*) Effect of light on the film.

Values

1 (*c*) Developing the film.

1 (*d*) Fixing the film.

2 (*e*) Write the equation representing the reaction in (*d*)

FOR ROUGH WORK (IF REQUIRED)

Values

5 **14.** Outline the method for the extraction of zinc from zinc sulphide. Give equations to illustrate the reactions involved.

4 **15.** In an experiment for the determination of the percentage of oxygen in potassium chlorate the following observations were made:

Weight of test tube	25.50 grams
Weight of test tube + potassium chlorate	27.90 grams
Weight of test tube + potassium chlorate, + manganese dioxide	29.10 grams.
Weight of test tube + contents after heating until all gas has been evolved	28.13 grams

Calculate the percentage of oxygen in potassium chlorate according to this experiment.

Values

16. The percentage composition of a certain carbohydrate was found to be: carbon 40%; hydrogen 6.67% oxygen 53.33%.

3 (*a*) What is the simplest formula of the compound?

5 (*b*) When 3.0 grams of this substance were dissolved in 100 grams of water, the solution was found to freeze at —0.31°C. Find the molecular formula of this carbohydrate.

FOR ROUGH WORK (IF REQUIRED)

[OVER]

Values

1 **17.** (*a*) What are isotopes?

2 (*b*) How did the discovery of isotopes help to explain why many elements have fractional atomic weights, as for example, chlorine with 35.46 and potassium with 39.10?

5 **18.** Metallic ores commonly contain large amounts of rocky materials. Outline the essential steps in the Froth Flotation process of concentrating zinc sulphide before the extraction of the metal.